CLAIMS

1. An object handling system for handling objects (OB) from object carriers (21) supporting objects (OB), the system comprising:
a support platform (3);
at least one carrier holder (5a-d) disposed to the support platform (3) and being configured to receive an object carrier (21) supporting objects (OB);
at least one analysis station (7) at which objects (OB) are analyzed;
an object handler (1) comprising a positioning mechanism (9) operable to provide for positioning in a region above the support platform (3), and a tool assembly (11) attached to the positioning mechanism (9) and being movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) which, in a carrier-sensing mode, is utilized in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and a holding tool (37) which, in an object-transfer mode, is utilized to hold an object (OB) at least in transferring the same between the at least one carrier holder (5a-d) and the at least one analysis station (7); and
a control unit (139) for controlling operation of the handling system.

2. The handling system of claim 1, wherein the support platform (3) comprises a grid, allowing the at least one carrier holder (5a-d) and the at least one analysis station (7) to be configured at positions on the grid in any desired configuration.

3. The handling system of claim 1 or 2, wherein at least one of the at least one carrier holder (5a-d) is configured to receive an object carrier (21) in only one orient.

4. The handling system of any of claims 1 to 3, comprising:

a plurality of carrier holders (5a-d) disposed to the support platform (3), each being configured to receive an object carrier (21) supporting objects (OB).

5. The handling system of any of claims 1 to 4, wherein the at least one analysis station (7) comprises a weighing unit.

6. The handling system of claim 5, wherein the weighing unit comprises a weigh cell (99) for weighing objects (OB) and a weigh plate (101) on which objects (OB) to be weighed are supported.

7. The handling system of claim 6, wherein the weigh plate (101) includes a plurality of recesses (111, 113) of different size for receiving objects (OB) of different kind.

8. The handling system of claim 7, wherein the recesses (111, 113) have different depths such as to provide that an object (OB) of any kind, when disposed in a respective one of the recesses (111, 113), has the same height relative to the support platform (3).

9. The handling system of any of claims 1 to 8, wherein the positioning mechanism (9) comprises a robotic arm.

10. The handling system of any of claims 1 to 9, wherein the tool assembly (11) comprises an attachment body (31) which is attached to the positioning mechanism (9), and a support unit (33) to which the sensor tool (35) and the holding tool (37) are attached and which is mounted to the attachment body (31) such as to be operable between a first, carrier-sensing configuration in which the sensor tool (35) is in an operative position and an object-holding configuration in which the holding tool (37) is in an operative position.

11. The handling system of claim 10, wherein the support unit (33) comprises a support member (41) which comprises a first arm (43) to which the sensor tool (35) is attached and a second arm (45) to which the holding tool (37) is attached, and a swivel mount (47) to which the support member (41) is coupled and which is attached to the attachment body (31), with the swivel mount (47) being operable to swivel the support member (41) between a first, carrier-sensing position in which the sensor tool (35) is in the operative position and a second, object-holding position in which the holding tool (37) is disposed in the operative position.

12. The handling system of any of claims 1 to 11, wherein the sensor tool (35) is an air nozzle unit from which an air flow is in use delivered, and further comprising:
an air catch sensor (135) which is pneumatically connected to the sensor tool (35) and operative to detect the presence of a surface proximate the sensor tool (35) by a change in the pressure of the delivered air flow.

13. The handling system of claim 12, wherein the sensor tool (35) comprises a body unit (57) which comprises a body (59) including a bore (61) which is pneumatically connected to the air catch sensor (135), and a nozzle unit (69) which comprises a nozzle (71) which is captively disposed in the bore (61) and extends outwardly of the body (59) and a biasing element (73) for biasing the nozzle (71) outwardly of the body (59), with the nozzle (71) including an air outlet (74) at a forward surface thereof from which an air flow is in use delivered and an air channel (75) which fluidly connects the air outlet (74) to the bore (61).

14. The handling system of any of claims 1 to 13, wherein the holding tool (37) comprises a plurality of gripping jaws (83a-c) which are operable

between a contracted configuration and an expanded configuration to grip and release objects (OB) in transporting the same.

15. The handling system of claim 14, wherein the gripping jaws (83a-c) define a first, outwardly-facing gripping surface (91) of a first diameter which, with the gripping jaws (83a-c) in an expanded configuration, acts to grip an inner peripheral surface of an object (OB) of one kind, and a second, inwardly-facing gripping surface (93) of a second diameter, greater than the first diameter, which, with the gripping jaws (83a-c) in a contracted configuration, acts to grip an outer peripheral surface of an object (OB) of another kind.

16. The handling system of claim 14 or 15, wherein the holding tool (37) further comprises an actuation mechanism for actuating the gripping jaws (83a-c) between contracted and expanded configurations.

17. The handling system of claim 16, wherein the actuation mechanism comprises a biasing element (87) for biasing the gripping jaws (83a-c) to one of a contracted or expanded configuration and a drive unit which is operable to overcome the bias of the biasing element (87) to drive the gripping jaws (83a-c) to the other of the contracted or expanded configuration.

18. The handling system of claim 17, wherein the biasing element (87) biases the gripping jaws (83a-c) to a contracted configuration and the drive unit is operable to drive the gripping jaws (83a-c) to an expanded configuration.

19. The handling system of claim 17 or 18, wherein the biasing element (87) comprises a resilient element.

20. The handling system of any of claims 17 to 19, wherein the drive unit comprises a diaphragm (85).

21. The handling system of any of claims 1 to 20, wherein the object handler (1) is operable, in a carrier-sensing mode and for each carrier holder (5a-d), to advance the sensor tool (35) successively through a plurality of predeterminable detection points to sense for a surface thereat, wherein the sensing of a surface at one of the detection points is indicative of the presence of an object carrier (21) of a respective known kind on the respective carrier holder (5a-d), thereby enabling the handling system to be configured to handle the objects (OB) on the respective carrier holder (5a-d) in accordance with a predeterminable handling routine.

22. The handling system of claim 21, wherein the presence of an object carrier (21) from a plurality of object carriers (21) of known different kind can be identified.

23. The handling system of claim 22, wherein the object carriers (21) of known different kind include an object carrier (21) of one kind in different state.

24. The handling system of any of claims 21 to 23, wherein the object handler (1) is operable to advance the sensor tool (35) along a single axis in the carrier-sensing mode.

25. The handling system of any of claims 1 to 24, further comprising:
a camera unit (117) for reading labelling, where provided, on the objects (OB) which are handled by the handling system.

26. The handling system of any of claims 1 to 25, further comprising:
a detector unit (133) for detecting the presence of an object (OB) at the at least one analysis station (7).

27. A method of handling objects (OB) from object carriers (21) supporting objects (OB), the method comprising the steps of:
providing an object handling system comprising: at least one carrier holder (5a-d) configured to receive an object carrier (21) supporting objects (OB); at least one analysis station (7) at which objects (OB) are analyzed; and an object handler (1) comprising a positioning mechanism (9) and a tool assembly (11) attached to the positioning mechanism (9) such as to be movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) for use in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and a holding tool (37) for holding an object (OB) at least in transferring the same between the at least one carrier holder (5a-d) and the at least one analysis station (7);
operating the object handler (1), for each carrier holder (5a-d), to advance the sensor tool (35) successively through a plurality of predeterminable detection points to sense for a surface thereat, and, on sensing a surface at one of the detection points, assigning the respective carrier holder (5a-d) as holding an object carrier (21) of a known kind having an associated handling routine; and
operating the object handler (1) to transfer objects (OB) from each identified object carrier (21) to the at least one analysis station (7) in accordance with the associated handling routine.

28. The method of claim 27, wherein the sensor tool (35) is advanced along a single axis in sensing a surface at each carrier holder (5a-d).

29. The method of claim 27 or 28, wherein the object carriers (21) can be of a plurality of known different kind.

30. The method of claim 29, wherein the object carriers (21) of known different kind include an object carrier (21) of one kind in different state.

31. The method of any of claims 27 to 30, wherein at least one of the at least one carrier holder (5a-d) is configured to receive an object carrier (21) in only one orient.

32. The method of any of claims 27 to 31, wherein the handling system comprises: a plurality of carrier holders (5a-d), each configured to receive an object carrier (21) supporting objects (OB).

33. The method of any of claims 27 to 32, wherein the at least one analysis station (7) comprises a weighing unit.

34. The method of any of claims 27 to 33, wherein the positioning mechanism (9) comprises a robotic arm.

35. The method of any of claims 27 to 34, wherein the tool assembly (11) comprises an attachment body (31) which is attached to the positioning mechanism (9), and a support unit (33) to which the sensor tool (35) and the holding tool (37) are attached and which is mounted to the attachment body (31) such as to be operated between a first, carrier-sensing configuration in which the sensor tool (35) is in an operative position and an object-holding configuration in which the holding tool (37) is in an operative position.

36. The method of claim 35, wherein the support unit (33) comprises a support member (41) which comprises a first arm (43) to which the sensor tool (35) is attached and a second arm (45) to which the holding tool (37) is attached, and a swivel mount (47) to which the support member (41) is coupled and which is attached to the attachment body (31), with the swivel mount (47) being operable to swivel the support member (41) between a first, carrier-sensing position in which the sensor tool (35) is in the operative position and a second, object-holding position in which the holding tool (37) is disposed in the operative position.

37. The method of any of claims 27 to 36, wherein the sensor tool (35) is an air nozzle unit from which a sensing air flow is delivered, and the handling system further comprises: an air catch sensor (135) which is pneumatically connected to the sensor tool (35) and operative to sense the presence of a surface proximate the sensor tool (35) by a change in the pressure of the delivered sensing air flow.

38. The method of claim 37, wherein the sensor tool (35) comprises a body unit (57) which comprises a body (59) including a bore (61) which is pneumatically connected to the air catch sensor (135), and a nozzle unit (69) which comprises a nozzle (71) which is captively disposed in the bore (61) and extends outwardly of the body (59) and a biasing element (73) for biasing the nozzle (71) outwardly of the body (59), with the nozzle (71) including an air outlet (74) at a forward surface thereof from which a sensing air flow is in use delivered and an air channel (75) which fluidly connects the air outlet (74) to the bore (61).

39. The method of any of claims 27 to 38, wherein the holding tool (37) comprises a plurality of gripping jaws (83a-c) which are operated between a contracted configuration and an expanded configuration to grip and release objects (OB) in transferring the same between the at least one object carrier (21) and the at least one analysis station (7).

40. The method of claim 39, wherein the gripping jaws (83a-c) define a first, outwardly-facing gripping surface (91) of a first diameter which, with the gripping jaws (83a-c) in an expanded configuration, acts to grip an inner peripheral surface of an object (OB) of one kind, and a second, inwardly-facing gripping surface (93) of a second diameter, greater than the first diameter, which, with the gripping jaws (83a-c) in a contracted configuration, acts to grip an outer peripheral surface of an object (OB) of another kind.

41. The method of claim 39 or 40, wherein the holding tool (37) further comprises an actuation mechanism for actuating the gripping jaws (83a-c) between contracted and expanded configurations.

42. The method of claim 41, wherein the actuation mechanism comprises a biasing element (87) for biasing the gripping jaws (83a-c) to one of a contracted or expanded configuration and a drive unit which is operated to overcome the bias of the biasing element (87) to drive the gripping jaws (83a-c) to the other of the contracted or expanded configuration.

43. The method of claim 42, wherein the biasing element (87) acts to bias the gripping jaws (83a-c) to a contracted configuration and the drive unit is operated to drive the gripping jaws (83a-c) to an expanded configuration.

44. The method of claim 42 or 43, wherein the biasing element (87) comprises a resilient element.

45. The method of any of claims 42 to 44, wherein the drive unit comprises a diaphragm (85).

46. The method of any of claims 27 to 45, further comprising the step of: reading labelling on ones of objects (OB) transferred from an object carrier (21).

47. The method of any of claims 27 to 46, further comprising the step of: detecting the presence of an object (OB) at the at least one analysis station (7) such as to provide for fail-safe modes, whereby no more than one object (OB) is transferred from the at least one object carrier (21) at any time.

48. An object handling system for handling objects (OB), the system comprising:
a support platform (3);
at least one carrier holder (5a-d) disposed to the support platform (3) and being configured to receive an object carrier (21) supporting objects (OB);
at least one location to which objects (OB) are transferred;
an object handler (1) comprising a positioning mechanism (9) operable to provide for positioning in a region above the support platform (3), and a tool assembly (11) attached to the positioning mechanism (9) and being movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) which, in a carrier-sensing mode, is utilized in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and a holding tool (37) which, in an object-transfer mode, is utilized to hold an object (OB) at least in transferring the same between the at least one carrier holder (5a-d) and the at least one location; and
a control unit (139) for controlling operation of the handling system.

49. The handling system of claim 48, wherein the at least one location comprises at least one object carrier (21) for supporting objects (OB).

50. The handling system of claim 48, wherein the at least one location comprises at least one analysing station (7) at which objects (OB) are analysed.

51. A method of handling objects (OB) from object carriers (21) supporting objects (OB), the method comprising the steps of:
providing an object handling system comprising: at least one carrier holder (5a-d) configured to receive an object carrier (21) supporting objects (OB); at least one location to which objects (OB) are transferred; and an object handler (1) comprising a positioning mechanism (9) and a tool assembly (11) attached to the positioning

mechanism (9) such as to be movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) for use in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and a holding tool (37) for holding an object (OB) at least in transferring the same between the at least one carrier holder (5a-d) and the at least one location;

operating the object handler (1), for each carrier holder (5a-d), to advance the sensor tool (35) successively through a plurality of predeterminable detection points to sense for a surface thereat, and, on sensing a surface at one of the detection points, assigning the respective carrier holder (5a-d) as holding an object carrier (21) of a known kind having an associated handling routine; and

operating the object handler (1) to transfer objects (OB) from each identified object carrier (21) to the at least one location in accordance with the associated handling routine.

52. The method of claim 51, wherein the at least one location comprises at least one object carrier (21) for supporting objects (OB).

53. The method of claim 51, wherein the at least one location comprises at least one analysing station (7) at which objects (OB) are analysed.

54. An object operating system for operating on objects (OB), the system comprising:

a support platform (3);

at least one carrier holder (5a-d) disposed to the support platform (3) and being configured to receive an object carrier (21) supporting objects (OB);

an object operator (1) comprising a positioning mechanism (9) operable to provide for positioning in a region above the support platform (3), and a tool assembly (11) attached to the positioning mechanism (9) and being movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) which, in a carrier-

sensing mode, is utilized in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and an operating tool which, in an object-operating mode, is utilized to operate on an object (OB); and
a control unit (139) for controlling operation of the operating system.

55. The operating system of claim 54, wherein the object operator (1) is operable, in a carrier-sensing mode and for each carrier holder (5a-d), to advance the sensor tool (35) successively through a plurality of predeterminable detection points to sense for a surface thereat, wherein the sensing of a surface at one of the detection points is indicative of the presence of an object carrier (21) of a respective known kind on the respective carrier holder (5a-d), thereby enabling the operating system to be configured to operate on the objects (OB) on the respective carrier holder (5a-d) in accordance with a predeterminable operating routine.

56. The operating system of claim 55, wherein the presence of an object carrier (21) from a plurality of object carriers (21) of known different kind can be identified.

57. The operating system of claim 56, wherein the object carriers (21) of known different kind include an object carrier (21) of one kind in different state.

58. The operating system of any of claims 55 to 57, wherein the object operator (1) is operable to advance the sensor tool (35) along a single axis in the carrier-sensing mode.

59. A method of operating on objects (OB) supported on object carriers (21), the method comprising the steps of:
providing an object operating system comprising: at least one carrier holder (5a-d) configured to receive an object carrier (21) supporting

objects (OB); and an object operator (1) comprising a positioning mechanism (9) and a tool assembly (11) attached to the positioning mechanism (9) such as to be movable thereby, wherein the tool assembly (11) comprises a sensor tool (35) for use in identifying any object carrier (21) as supported by the at least one carrier holder (5a-d), and an operating tool (37) for operating on an object (OB);
for each carrier holder (5a-d), advancing the sensor tool (35) successively through a plurality of predeterminable detection points to sense for a surface thereat, and, on sensing a surface at one of the detection points, assigning the respective carrier holder (5a-d) as holding an object carrier (21) of a known kind having an associated operating routine; and
operating the object operator (1) to operate on objects (OB) on each identified object carrier (21) in accordance with the associated operating routine.

60. The method of claim 59, wherein the presence of an object carrier (21) from a plurality of object carriers (21) of known different kind can be identified.

61. The method of claim 60, wherein the object carriers (21) of known different kind include an object carrier (21) of one kind in different state.

62. The method of any of claims 59 to 61, wherein the sensor tool (35) is advanced along a single axis.

63. An object handling system for handling objects (OB) from object carriers (21) supporting objects (OB) substantially as hereinbefore described with reference to the accompanying drawings.

64. A method of handling objects (OB) from object carriers (21) supporting objects (OB) substantially as hereinbefore described with reference to the accompanying drawings.

65. An object operating system for operating on objects (OB) supported on object carriers (21) substantially as hereinbefore described with reference to the accompanying drawings.

66. A method of operating on objects (OB) supported on object carriers substantially as hereinbefore described with reference to the accompanying drawings.